Lake Street-Marshall Avenue Bridge
Spanning the Mississippi River
at Lake Street and Marshall Avenue
Minneapolis
Hennepin County
St. Paul
Ramsey County
Minnesota

HAER No. MN-6

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Rocky Mountain Regional Office
National Park Service
U. S. Department of the Interior
P. O. Box 25287
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HISTORIC AMERICAN ENGINEERING RECORD

Lake Street-Marshall Avenue Bridge

HAER No. MN-6

Location: Spanning the Mississippi River at Lake Street and Marshall Avenue on Minnesota Legislative Route 108 (formerly Trunk Highway 212) in the cities of Minneapolis, Hennepin County, and St. Paul, Ramsey County, Minnesota

UTM: A: 15.483840.4977020 B: 15.484260.4977040
Quad: St. Paul West
Latitude: A 44 37' 29" B 44 37' 29"
Longitude: A 93 12' 32" B 93 12' 14"

Date of Construction: 1888; modified in 1905-1906

Builder: Superstructure: Wrought Iron Bridge Company of Canton, Ohio
Substructure: J. F. O'Halloran Company

Present Owner: Minnesota Department of Transportation (Mn/DOT)

Present Use: Vehicular and pedestrian bridge, to be replaced by a new vehicular and pedestrian bridge. Projected date of removal is 1989.

Significance: The bridge is a major 19th century engineering accomplishment and has been a significant transportation link for nearly 100 years. Constructed entirely of wrought iron with a wooden deck, the bridge was at that time the second longeet-span metal arch bridge in the United States, exceeded only by the Eads Bridge in St. Louis. Today, the Lake Street/Marshall Avenue Bridge is still the fourth longest-span 19th century metal arch bridge remaining in the United States and is the longest-epan three-hinged arch bridge eurviving in the country.[1] The bridge has been, and continues to be, a significant transportation link between the cities of Minneapolis and St. Paul. In 1961, before the opening of Interstate 94, the bridge was one of the heaviest traveled, two-lane bridges in the United States, carrying over 25,000 vehicles per day.[2]

In December 1979, the Keeper of the National Register, concurring with the Minnesota State Historic Preservation Office, and the Federal Highway Administration, certified the Lake Street-Marshall Avenue Bridge as eligible for inclusion on the National Register of Historic Places.

Historian: Alan Kramer
Minnesota Department of Transportation
December 1987

I. ADMINISTRATIVE AND ECONOMIC HISTORY

The 1880s have been described as the beginning of the golden age of western cities, when "every city dreamed of becoming a new Chicago."[3] St. Paul and Minnesota were major players in this drama of the golden age and used their unique geographic opportunities to grow as dramatically, as they competed with each other during this era.

St. Paul, located at the head of navigation on the Mississippi River, became a major transportation center, attracting railroads, warehouses, and livestock packing operations. Minneapolis, on the strength of its mills located at St. Anthony Falls on the Mississippi River, became the nation's largest primary wheat market and a major force in the lumber industry. In the peak year of 1899, the city became the world's leading lumber market.[4]

St. Paul and Minneapolis were experiencing boom times for both their industries and populations. Minneapolis managed to surpass St. Paul during the census wars of the period. Between the years 1880 and 1895, the population of Minneapolis more than quadrupled, reaching 192,833, while St. Paul's population more than tripled to 140,292. By 1890, Minneapolis was the nation's eighteenth largest city, and St. Paul ranked twenty-third.[5]

During this period, "both cities extended their limits to absorb the territory separating them, speeding towards the day when a traveler might pass from one to another without noticing a division."[6] A major natural division between the cities occurred at the banks of the Mississippi River, with Minneapolis located on the west side and St. Paul on the east side. Many bridges were constructed in the 1880s across this chasm to connect the growing suburbs of the "Twin Cities," as they had been increasingly referred to in the local press.

By 1886, interest in a Mississippi River connecting south Minneapolis with St. Paul resulted in an official request at a December 17, 1886, meeting of the Minneapolis City Council. Mr. R. P. Russell, Jr., and unidentified others, submitted a request asking that "the council take such action as will cause the immediate construction of a wagon bridge across the Mississippi River at the foot of Lake Street." Interest was keen enough to spur the adoption of a motion at the same meeting by Alderman George W. Cooley, instructing the city engineer to "... cause the necessary surveys and soundings to be made across the Mississippi River at Lake Street, for an iron highway bridge 38 feet wide, with two sidewalks eight feet wide ..."[7]

On January 7, 1887, the City Council's Standing Committee on Roads and Bridges, in response to their review of the proposal, recommended that the proposed plans and estimates not to be adopted. Alderman Cooley, supported by a petition from citizens of both Minneapolis and St. Paul, attempted to convince the council to appoint Minneapolis members to a special intercity committee to study the bridge issue. Cooley's implementing motion failed to obtain sufficient council support.[8] The Minneapolis Tribune apparently was not convinced of the need for a bridge at this location, editorializing that such construction was a foolish extravagance, since scarcely anyone lived in that district, and, anyway, the cities were sufficiently well served by the seven bridges already in existence.[9]

By February, the State Legislature was considering a bill which would allow Hennepin and Ramsey counties to issue bonds and to jointly construct a bridge at Lake Street and Marshall Avenue. The Hennepin County delegation in the legislature asked the city of Minneapolis to express its official position on this bill. Alderman Cooley's motion to support the bill failed to gain majority support. In its place, the council passed a motion on February 18, 1887, stating that "...the City Council respectfully decline to express any further opinion in the matter."[10]

Ramsey County's Board of Commissioners had already expressed their feelings on February 8, 1887, in a resolution "...in favor of the proposed bridge on Marshall Avenue in Ramsey County believing that said bridge will be conducive to the best interests of the City and County..." On May 6, 1887, the Ramsey County Board appointed three commissioners to confer with the commissioners of Hennepin County, to ascertain cooperation in the joint venture of constructing a bridge connecting Marshall Avenue in Ramsey County with Lake Street in Hennepin County. A meeting of both boards followed on June 7. On July 12, 1887, the Ramsey County Board authorized the issuance of $75,000 in bonds, paying 4-1/2 percent interest for a thirty year period. This was in accordance with an act of the State Legislature, approved on February 26, 1887.[11]

Hennepin County apparently was able to finance its share of the project because, on October 12, 1887, the Ramsey County Board approved a contract awarding the construction of the bridge superstructure to the Wrought Iron Bridge Company of Canton, Ohio, for the sum of $109,100.[12] The contract for the substructure was awarded to the J. F. O'Halloran Company, which submitted the low bid of $33,136.90.[13]

Joseph R. Sewall of St. Paul was the engineer employed by the Joint Board of Commissioners of Hennepin and Ramsey counties to design the bridge. The final construction drawings were prepared by the Wrought Iron Bridge Company and approved by Sewall. The bridge was completed in 1888, most of the work having been done during that year's cold winter.

Two years later, Hennepin and Ramsey counties were prepared to turn ownership and maintenance responsibility of the new bridge over to Minneapolis and St. Paul, respectively. Records of the Ramsey County Board of Commissioners reveal a county resolution passed on March 17, 1890, enabling such a transfer. On March 20, 1890, the St. Paul Common Council passed Ordinance 1340, accepting all Ramsey County's rights and interests in the bridge and accepting responsibility to maintain half of the bridge.[14]

II. THE THREE-HINGED ARCH BRIDGE

A. Design and Description

Joseph S. Sewall adapted his bridge design to the dramatic natural topography of the site. The Mississippi River gorge had been carved by the receding of St. Anthony Falls from its origin near the confluence of the Minnesota River to its present location almost 4.5 miles upstream. This process had occurred over the past 10,000 years, after the last ice age. The retreat of the falls was finally halted in the 1870s when a spillway was constructed to prevent the further erosion that mill operators feared would ultimately destroy the falls and their source of power.[15] The Lake Street-Marshall Avenue Bridge was located midway up the eroded gorge, where the elevation from the bed of the then-shallow water to the top of the bluff was 120 feet and the width across was over
1,200 feet.

The design developed by Sewall used two 456-foot-long deck arches to cross the Mississippi River channel. These arches are three-hinged with hinges at the bases and crown of each arch to allow for expansion and contraction movements caused by temperature changes. Three 19-foot-long towers rest on stone piers and connect the arches together in mid stream and connect the arch ends to approach trusses. The approach trusses are deck Pratt trusses, 133-feet-long on the west end and

95-feet-long on the east end. The remainder of the 1,271-foot-long bridge is made of four trestle approach panels, 17-, 19-, 19-feet-long on the west end and 19-feet-long on the east end. The arch spans were spaced 29 feet apart, center to center, and the approach trusses and trestle posts were spaced 17 feet inches, center to center. The three piers were originally constructed on dry land, one on each bank of the river and one on an island in mid stream. The bridge deck, 120 feet above the river bed, originally incorporated an 18-foot-wide roadway, with a 6-foot-wide sidewalk on either side. The sidewalks were cantilevered on brackets outside of the approach spans, but were contained within the width of the main arch sections.

An article appearing in the December 7, 1895, Engineering Record describes the bridge as follows:

> "The bridge was built in 1888 in conformity to the general requirements and specifications of Mr. Sewall, and is made entirely of iron, no steel being permitted to enter into the construction, and has details and construction familiar in advanced high-grade bridge work. The main arches have a system of triangular trussing between the polygonal arch member or bottom chord and the horizontal top chord, with pin connections at intersections of these members only, thus constituting practically three-hinged arches, which at the ends of the top chords are carefully disconnected from the adjacent structure so as to avoid possibility of continuous girder action. The main arch trusses are vertical and parallel, with lateral bracing between them at top and bottom, and across diagonal bracing in vertical planes at panel points and sub-panel points. Main truss intersections are pin-connected ... and all other secondary members have riveted connections."[16]

Wrought iron was the material of choice for the bridge structure. Steel was yet a relatively new material and its potential was still evolving, although the Eads Bridge in St. Louis had been constructed of steel in 1874. The Eads Bridge was required to carry a double railroad track on a separate level, in addition to normal street traffic, and thus was better able to use the higher-technology metal with its greater strength. Wrought iron had been used in bridges for over 100 years, and its strength and stable qualities were well-known and well-suited for use on Lake Street-Marshall Avenue Bridge, with its 18-foot-wide deck carrying horse-drawn vehicles.

No metal less than 5/16-inch thickness was used.[17] Diameters of the connecting pines ranged from 1-3/4 inches to 9/14 inches. The 9/14 inch diameter pins were 33 inches long and were used to hinge the arch bases.

Wood was used for flooring and joists on the main roadway and sidewalks. The design allowed the bridge to carry a live load of 100 pounds per square foot, or 10 tons on a width of 4 feet.[18]

B. Construction

The erection of the Lake Street-Marshall Avenue Bridge was carried out during the winter of 1887-1888. The weather was exceptionally cold that year. The January mean temperature was -2.9 degrees Fahrenheit, 14 degrees below the normal January mean of +11.2 degrees. The record low metropolitan-area temperature of -41 degrees was also recorded that January.[19] The ice of the frozen Mississippi River provided a convenient working platform.

Pier foundations had been constructed of stone on dry land on both banks of the river and on an island in mid stream. The river bank foundations were constructed on rock outcroppings, and the center pier foundation was excavated to sandstone bedrock. During erection, the iron work was supported by a temporary falsework system consisting of 23 framed trestle bents fabricated with four 12x12-inch posts each. These trestle bents were set on pile foundations which, in warmer weather, had been driven to rock through an average of 5 feet penetration.[20] After construction of the first arch was completed, the falsework was moved across the ice and used to support the second arch during its assembly. Construction of the arches differed from the usual method of working from both ends towards the center. In this case, work began on the west end and continued directly across the eastern terminus. An article appearing in the September 24, 1898, Engineering Record described the assembly process in the following manner:

> "The viaduct and first main tower at the west end having been erected on falsework, an overhanging traveler...was built and run out on top of it until its arm projected far enough beyond the pin to set the skewback and first panel and connected members to that end of the arch span. When this was self-sustaining the traveler track was continued on top of it, and the traveler was advanced to assemble the next panel of the arch...The traveler was operated by a six spool hoisting engine which was kept in a fixed position just beyond the first end during the erection of each span. There was 6 feet headway under the working floor of the traveler, which enabled material cars to bring out all the iron work from the shore on the center track of the structure between the traveler rails, run through and under the traveler, and deliver it convenient to the traveler tackles on the overhang."[21]

Main structural intersections of the bridge were connected with pins to allow for movement. The remainder of the structure was assembled with rivets. The riveting process was somewhat of a circus act with four members on a typical riveting crew. A "heater" operated a forge set up on the ice below to heat the rivets until they were red hot and malleable. The "heater" would throw the rivets up to the "catcher," who would catch them in a metal funnel-shaped device and, with tongs, insert the rivet in the holes of the members to be joined. A "bucker" would then step into place and firmly brace himself against the head of the rivet with a heavy passive tool, while the fourth man would beat the other end of the rivet with a hammer until it had filled the hole and formed a secure, rounded head.

Though no record of the actual source of the iron materials in the bridge has been located, it would have been common practice at that time for the contractor, the Wrought Iron Bridge Company, to fabricate the materials in its shops in Canton, Ohio, and to ship them to the site for assembly. E. J. Landor was the chief engineer for the bridge company, and William F. Hall was its superintendent. Edward F. Terry was the superintendent in charge of the actual erection.[22]

C. Modifications

1. 1905-1906 Widening

Despite the Minneapolis Tribune's admonition 17 years earlier that construction of the bridge was a "foolish extravagance," by 1905 the bridge was insufficient to accommodate the growing traffic demands. The Twin City Rapid Transit Company (TCRT), which operated the electrified street railways of Minneapolis and St. Paul, desired to establish a new interurban line between the two cities along Lake Street and Marshall Avenue.[23] To accomplish their plan, the bridge would require widening and strengthening to carry two sets of streetcar tracks in addition to normal street traffic. Street cars in use at that time weighed up to 40 tons apiece, considerably more than the horse wagon traffic the bridge was originally designed to accommodate. The railway company sought permission from the cities to perform the necessary modifications itself. On March 31, 1905, the Minneapolis City Council adopted a motion by Alderman Dennis C. Bow, approving such modifications subject to the following provision:

> That any changes in the construction of the Lake Street Bridge in said City, to be made by the Minneapolis Street Railway Company, shall be made in accordance with plans to be approved by the City Engineer of said City; and that such changes shall be made under his direction and with his approval.[24]

Work on the modifications began in October 1905, and the completed bridge was placed back into service about June 1, 1906.[25] On August 1, 1906, City Engineer Andrew Rinker reported to the City Council that the modifications had been completed by the TCRT in accordance with plans approved by himself. Following Rinker's recommendation, on August 10, 1906, the city council accepted the remodeled bridge.[26]

The roadway was widened 18 feet to 33 feet to accommodate two streetcar tracks placed 10 feet center to center. A third (middle) truss was added to all spans and the floor beams were strengthened where necessary to transmit the increased loads. A detailed description of the reconstruction process can be found in the February 14, 1907, Engineering News. The process is summarized as follows:

> "The old approach span and trestle posts were moved from their original 17 feet 6 inches center to center width to 32 feet 6 inch center to center. a new and stronger truss of the same general dimensions as the old was placed in the centerline of the bridge between them.
>
> The old arch truss was left in their position of 29 feet center to center. To achieve the 33-foot roadway width, the sidewalks were relocated from inboard the arches to cantilevered brackets on the outside, as had been the original design on the approach spans. A new arch truss was constructed along the centerline of the bridge. This arch was assembled from steel and is heavier and considerably stronger than the original wrought iron arches.
>
> The old wood flooring and joists were entirely replaced and new steel track stringers were placed under the streetcar rails. With the additional support provided by the new center truss system, the old floor beams were determined to have sufficient strength to support the new loads."
>
> The old towers were reinforced with new center posts and transverse and longitudinal bracing. The old stone foundations were partially reconstructed with concrete to provide sufficient bearing.[27]

The erection of the new work started on the east end of the bridge in October 1905, and continued through the winter. As the Engineering News reported:

> "During that time many difficulties were met and overcome, and it is a notable fact that there was not a single serious accident either to workmen or material, although the work was carried on in all kinds of weather."[28]

A combination of old and new materials was used in the reconstruction. Many of the old materials were rebuilt at shops located about two miles from the bridge site. The approach spans were completed prior to constructing the new center arch trusses. Although the span of the new arches is the same as the old, the bottom chord is 5 feet 9 inches lower at the crown and 4 feet higher at the end pins. This geometry was necessary to achieve adequate truss depth without disturbing the old floor beams and top and bottom lateral bracing of the existing arches. The total weight of the new steel in the reconstructed bridge was 1,050 tons. The total cost of the reconstruction, including foundations and wood flooring, was nearly $100,000, and was paid for by the TCRT Company.[29]

Construction tools had become more sophisticated in the 18 years since the original bridge construction. A steam-powered, self-propelled flatcar with a derrick was used in the 1905 project. Riveting tools and drills were now pneumatically driven, powered by a compressor located on the island in the center of the river. For economical reasons, no falsework was used in the reconstruction, and temporary supporting measures were tailed to this constraint.[30]

Frankman Bros. and Morris, of St. Paul, performed the actual erection of the new work under the general supervision of George L. Wilson, chief engineer of the TCRT, and University of Minnesota Professor of Structural Engineering, Frank H. Constant, who was retained by the transit company as consulting engineer. The Minneapolis Steel and Machinery Company was the general contractor. Ralph Modjeski, a consulting engineer from Chicago, was in charge of the shop inspections.[31] William S. Hewett designed the modifications.[32]

When completed, the reinforced bridge was able to carry the following live loads:

Wheel Loads: Three 36-ton or two 40-ton, double truck cars 45 feet long on each track; 18,000 pounds per axle; truck wheelbase 5 feet, center to center of trucks 22 feet.

Together with the following distributed loads on the portion of roadway not covered with cars:

Floor system:	100 pounds per square foot
Sidewalks:	80 pounds per square foot
Approach trusses:	100 pounds per square foot
Arch trusses:	60 pounds per square foot[33]

2. Cofferdam Pier Protection

In 1917, the U. S. Army Corps of Engineers completed the construction of Lock and Dam No. 1, 2.3 miles downstream from the Lake Street-Marshall Avenue Bridge. The dam is commonly known as the Ford Dam because of its proximity to the Ford Motor Company plant, which won the Federal license to generate power from the dam's 37-foot head.[34] The dam finally allowed barges to navigate to Minneapolis and provided a slack-water basin for harbor operations. St. Paul had been displaced as head of navigation on the Mississippi River, a position that Minneapolis had long coveted.

At the Lake Street-Marshall Avenue Bridge, the once shallow, rapid stream was transformed into a slow-moving river, 25 feet higher in elevation. At normal water levels, the bases of the arches were now submerged under 3 to 6 feet of water. At high levels, the water was raised 21 feet above the bases of the outer arches and 18 feet above the center pier arch bases.[35]

Construction of the dam began in 1910. After seven years of warning and considerable discussion, the cities had still not agreed on the methods to protect the arches from the effects of the raised water levels. In late 1917, the cities finally decided to independently construct cofferdams on their respective sides of the river and to cooperate on the center piers. The water level behind the completed dam was subsequently lowered 15 feet to facilitate the construction of the cofferdams. The east pier contract was let to Thorton Bros. Co. of St. Paul in November 1917 for $9,783. The center pier was completed in March 1918 by Fielding and Shepley at a cost of $19,196, shared equally by St. Paul and Minneapolis.[36]

After much discussion and disagreement over protection methods, the cities agreed to construct concrete cofferdams around each pier. Minneapolis and St. Paul each built their own structure and cooperated on the center pier protection. The cofferdams rise 6.24 feet over the normal pool elevation of 725.1 feet above sea level.[37] Hand-operated pumps were installed to evacuate accumulated water from within the cofferdams. Rustproofing was applied to the metal superstructure to 4 feet above expected flood stage.

The cofferdams have long since cracked and flooded, the rustproofing has worn off, and the pumps are inoperative.

D. Repair and Maintenance History

The bridge has been redecked, paved and painted a number of times. These and other events in the bridge's history have been documented in records maintained by Mn/DOT and the Public Works Department of St. Paul

and Minneapolis and are listed in the Events Schedule contained in Section VII. Some of the more significant events are described below:

* In 1925 and 1926, street lighting and guardrail were installed. The cities were apparently able to agree on the style of street lighting fixture, but they each installed their own design of guardrail. St. Paul used a cable design, while Minneapolis used solid metal construction. The street lighting remained consistent until the 1950s, when Minneapolis updated the fixtures on its half of the bridge.

* In the mid-1940s, various studies were conducted by the cities and the Highway Department concerning the fsasibility of widening the bridge to accommodate separate lanes of automobile traffic in addition to the streetcar lines. It was determined that the costs far outweighed the benefits, and that a new bridge would be the best solution.

* In 1951, the posted load limit on the bridge was raised to a uniform 15 tons on the approaches from both sides of the river. The previous load limit history is somewhat vague, although, in 1944, both cities had 10-ton limits posted. By early 1951, the St. Paul approach was posted at 15 tons, while Minneapolis was still at 10 tons.

* Record spring flooding on the Mississippi River in 1965 resulted in erosion and undermining around the center pier. In June 1965, the Minnesota Highway Department used Federal flood emergency aid to place riprap around the pier to halt further undermining. Stone and rubble from the dismantled Washington Avenue Bridge upstream were placed as riprap. Later soundings indicate some movement of this rock, surprising in view of the one-cubic yard size of each piece of granite.

* On December 10, 1965, a routine inspection by a St. Paul bridge maintenance crew discovered seriously damaged structural members on the downstream arch. The damage was presumed to have resulted from a barge collision occurring sometime since July of that year. The bridge was immediately closed to heavy traffic and temporary blocking was installed. The Highway Department and the city of St. Paul collaborated to perform repairs, and the bridge was reopened to all traffic on December 17, although repair work continued for another six days.

* In 1969, the city of St. Paul reconstructed Mississippi River Boulevard with a grade separation at Marshall Avenue. To accomplish the separation, a small bridge (No. 62518) was constructed over the parkway at the sast end of the Lake Street-Marshall Avenue Bridge.

The west abutment of Bridge No. 62518 intersects the east abutment wingwalls of the Lake Street-Marshall Avenue Bridge; no revisions were made to the main bridge.

* In 1979, a comprehensive inspection of the bridge was conducted by the Minnesota Department of Transportation (Mn/DOT). The city of St. Paul supplied a "Snooper" to aid in the inspection, since Mn/DOT's vehicle was too heavy for the bridge's weight limit. The inspection report summarized the condition of the bridge "as not all that bad." The main problem areas requiring attention were severely corroded lacing bars in the tower members, sidewalk brackets, and 8-inch I-beams under the roadway curbs. Many of these items showed 100 percent loss of section. Repairs were made to allow continued safe use of the bridge. Restrictions were subsequently placed on the 20-ton transit buses that crossed the bridge 200 times a day. These restrictions required that the buses travel no more than 10 miles per hour along a path near the centerline of the bridge over the stronger center arch.

* A similar inspection and repair process was carried out in July 1987. A traffic survey conducted at this time revealed compliance problems with weight restrictions and speed problems with privately-operated buses. To ensure safe operation and avoid closing until the staged replacement bridge is ready, the bridge was closed to all traffic over 5 tons and the speed limit was reduced to 20 miles per hour. To maintain service for the 2,000-2,500 passengers crossing the river daily, the Metropolitan Transit Commission commenced the use of small vans to shuttle riders across the bridge.

III. BIOGRAPHIES

A. Joseph S. Sewall

Joseph S. Sewall was the designer of the Lake Street/Marshall Avenue Bridge. The use of long arch spans was an innovation in bridge engineering, and Sewall's concept was copied by bridge builders all over the United States.[38] In 1856, Sewall had completed a 150 -foot wooden bridge of this type at Taylors Falls, Minnesota. That bridge was the first structure to cross the St. Croix River.[39]

Originally, from Boston, Sewall first worked as a railroad survey, a common practice for civil engineers in those days.[40] Sewall was appointed engineer of the St. Paul Bridge Company in June 1856. This company had been created by an act of the Territorial Legislature in March 1854, and was the city of St. Paul's hope in its competition with Minneapolis to construct the first crossing of the Mississippi River. St. Paul lost the race because of financial difficulties, while

Minneapolis completed the Hennepin Avenue suspension bridge in 1855. St. Paul's first river crossing was completed in 1859, at Wabasha Street. Sewall designed and supervised the construction of the 1,300-foot long wood and iron Howe truss.[41] Its iron and steel replacement in 1872 was again designed by Sewall. Sewall served as St. Paul's city engineer from 1874 until 1880. During this tenure, he also built the original bridge across the Mississippi River at Fort Snelling in 1879.[42] Sewall's most enduring and notable design was the Lake Street-Marshall Avenue Bridge, completed in 1888.

B. William S. Hewett

William S. Hewett designed the 1905 widening and strengthening of the Lake Street-Marshall Avenue Bridge for the Twin City Rapid Transit Company (TCRT). He had established his own bridge company after a decade of apprenticeship with his uncle, Seth Hewett, a highway bridge contractor. Originally from the east coast (State of Maine), as was Sewall, Hewett followed Sewall's footsteps as he constructed the Lake Street-Marshall Avenue Bridge and built a steel-truss replacement bridge at the Fort Snelling crossing. Over his career, Hewett developed specialized skills in the design of steel bridges and pioneered in the use of reinforced concrete structures. Hewett had a productive relationship with the TCRT Company, designing all the bridges required by the system on a cost-plus basis.[43]

C. Wrought Iron Bridge Company

The Wrought Iron Bridge Company of Canton, Ohio, fabricated and built the Lake Street-Marshall Avenue Bridge from the plans designed by J. S. Sewall. The company was formed in 1865 by David Hammond, as an outgrowth of the partnership of Hammond and Reeves. In the previous year, Hammond had teamed with Washington Reeves, a local metal worker, to further his pursuit of building a better bridge. Common practice had been to build bridges entirely of wood. Hammond combined his construction background with the expertise of Reeves and the local foundry owned by John Laired to develop the first combination iron and timber bridges and finally all-iron bridges. Reeves' disinterest in company expansion resulted in dissolution of the partnership in 1870.[44]

The Wrought Iron Bridge Company was incorporated in 1871, with $100,000 capital. The company almost immediately joined the ranks of the country's leading bridge builders. Business grew from $200,000 in 1871 to $500,000 in 1873, and at which point it continued into the 1880s. By 1880, the company had built 3,300 bridges and was reported to have built more highway bridges than any other firm in the country. The bridges had been erected in 25 States and Canada. In 1890, the company constructed the south half of the still-standing Hennepin Avenue steel arch bridge in Minneapolis. E. J. Landor, the first college-trained

engineer in Canton, entered the company in 1877 and became chief engineer in 1886, the year before construction began on the Lake Street-Marshall Avenue Bridge. In 1899, the company was purchased by the American Bridge Company, becoming one of 35 plants of this $67 million operation. The Great Depression forced the plant to close in 1932.[45]

D. Twin City Rapid Transit Company

The Twin City Rapid Transit Company (TCRT) performed the major reconstruction of the Lake Street-Marshall Avenue Bridge in 1905-1906, widening the roadway from 18 to 33 feet to accommodate two streetcar lines in addition to normal traffic. The addition of the steel arch along the centerline of the bridge allowed the added load to be carried and has kept the bridge in service to this day.

The TCRT, with William S. Hewett as designer, built many significant bridges in the Twin Cities, including the still standing Interlachen (William Berry) Bridge in Minneapolis and Lexington Avenue Bridge in St. Paul, both over the former Como-Interurban-Harriet Line. These bridges were built using the Melan principle of steel reinforced concrete, which Hewett introduced to the Twin Cities.[46]

The TCRT was formed in 1891 in the merger of the St. Paul Street Railway Company and the Minneapolis Street Railway Company. These companies had begun operation in 1872 and 1875, respectively, and originally relied on horses to pull vehicles along the tracks. In 1880, almost two million passengers rode the lines.[47] By 1892, the entire system had been converted to electric power. The cost of this conversion had forced the merger of the two companies. Streetcars grew more popular, as residential areas began to sprawl further from the central cities.

The end of the TCRT street railway system came rapidly in the early 1950s, as the system was converted to buses while the electric system was pillaged and sold for illegal profits by a group that had taken control only five years earlier. As a result of the scandal, a number of people were indicted and sentenced to prison terms.[48] The electric railway system was history, and, in 1954, the last streetcars crossed the Lake Street-Marshall Avenue Bridge that had been modified to accommodate their mass and size.

IV. EVENTS SCHEDULE

A. History through 1987

Year	Date	Event
1887-1888		Original construction by Ramsey and Hennepin counties.
1890		Transfer of ownership to cities of St. Paul and Minneapolis.
1905-1906	October to June	Widening and strengthening to accommodate two sets of streetcar tracks.
1914		Painting, new decking and paving.
1917		Cofferdam construction around piers.
1925		Painting
1925-1926		New decking and stringers. Installation of street lighting and guardrail (rail of different design on each city's half).
1933	December	Highway Commissioner's Orders Nos. 8488 (for St. Paul) and 8719 (for Minneapolis) designating Legislative Route 108 along Marshall Avenue and Lake Street
1944-1946		Strength analyses determine that widening of present bridge is not feasible; a wider, stronger crossing will require a new bridge.
1951		Load limit raised to a uniform 15 tons maximum live load on both Minneapolis and St. Paul approaches to bridge.
1952		New deck--concrete replaced wood in center portion containing streetcar rails.
1954		Suspension of streetcar traffic.

Year	Date	Event
1965	June	Federal flood emergency aid used to place riprap around eroded center pier.
1965	December	Repair of main arch member apparently damaged by barge collision.
1966		Repave area between streetcar rails.
1969		Construction by city of St. Paul of Bridge No. 62518 to create grade separation with Mississippi River Boulevard.
1979	May-June	Indepth bridge inspection and repairs of deteriorated sections.
1979	October	Restrictions placed on bus traffic-- 10 mph speed and travel in stronger center section.
1986		Repave deck and remove remaining streetcar rails.
1987	July	Indepth bridge inspection and repairs.
1987	August	Bridge closed to all buses and trucks over 5 tons. MTC begins shuttle van service.

B. Proposed Construction Schedule

1988	Spring	Begin staged construction of replacement bridge.
1989	Spring	Traffic is diverted to two complete lanes of new bridge. Old bridge is removed in 1989.
1989	Fall	New four-lane bridge is completed.

V. ORIGINAL CONSTRUCTION BIDS

Reproduced from The Engineering News, Vol. 18, October 15, 1987

St. Paul, Minn. - The following were the bids for the bridge to connect Marshall Ave. St. Paul, and Lake Ave. Minneapolis; Superstructure; Wrought Iron Bridge Co., Canton O. $109,100; Milwaukee Bridge Works, Milwaukee, Wis. $114,505; Horace E. Horton, Rochester, Minn. $115,000; Shiffler Bridge Works, Pittsburgh, Pa. $129,000; King Iron Bridge & Manufacturing Co., Cleveland, O. $135,000; Smith Bridge Co., Toledo, O. $135,000. A Gottlieb & Co., Chicago, Ill. $148,000; Union Bridge Co., Buffalo, N.Y. $156,530. The contract was awarded to the Wrought Iron Bridge Co..

Substructure; J. F. O'Halloran $33,136.90; Thornton & Shaw $33,264.50; Ring & Tobin $32,851.50; (Mankato limestone) and $34,420.50; (Kettle River sandstone); P. Durak $34,987.50; Minnesota Stone Co. $37,007.50; Sauer Bros. $38,903.00. The contract was awarded to J. F. O'Halloran.

The engineer is J. S. Sewall, St. Paul, Minn.

FOOTNOTES

1 Henry Gratten Tyrell, History of Bridge Engineering, (Chicago, 1911), pp. 324, 363-364.

2 Highway Research Board of the National Academy of Sciences-National Research Council, Highway Capacity Manual 1965, (Washington, D. C., 1965), p. 23.

3 Lucille Kane and Alan Ominsky, Twin Cities: A Pictoral History of St. Paul and Minneapolis (St. Paul: Minnesota Historical Society Press, 1983), p. 45.

4 Ibid, p. 82.

5 Ibid, p. 81.

6 Ibid, p. 83.

7 City of Minneapolis, Proceedings of the City Council, XII, December 18, 1886, pp. 594-595.

8 City of Minneapolis, Proceedings of the City Council, XII, January 7, 1887, p. 613.

9 Minneapolis Tribune, 1887, cited in Nicholas Westbrook, editor, A Guide to the Industrial Archaeology of the Twin Cities, (St. Paul, 1983), p. 25.

10 City of Minneapolis, Proceedings of the City Council, XII, pp. 659-664.

11 Proceedings of the Ramsey County Board of Commissioners, 1886-1890, Vol F, pp. 137, 169, 176, 194, as noted in WPA History Records Survey, box 254 at the Archives and Manuscripts Division of the Minnesota Historical Society.

12 Proceedings of the Ramsey County Board of Commissioners, p. 240.

13 The Engineering News, XVIII, (October 15, 1887), p. 285.

14 Proceedings of the Ramsey County Board of Commissioners, pp. 531, 578-579.

15 Nicholas Westbrook, editor, A Guide to the Industrial Archaeology of the Twin Cities, (St. Paul, 1983), p. 11.

16 "The Minneapolis Arch Bridge," The Engineering Record, XXXIII, (December 7, 1895), p. 5.

17 Frank H. Constant, "Strengthening the Three-Hinged Arch Bridge over the Mississippi River between Minneapolis and St. Paul, Minn.," The Engineering News, LVII, (February 14, 1907), p. 171.

18 Loc. cit.

19 Bruce Watson and Jim Gilbert, Minnesota Weatherguide Calendar, (Navarre, 1987).

20 "Erection of the Lake Street Arch Bridge, Minneapolis," The Engineering Record, XXXVIII, (September 24, 1898), p. 356.

21 Ibid., pp. 356-357.

22 Ibid., p. 357.

23 Constant, loc. cit.

24 City of Minneapolis, Proceedings of the City Council, XXXI, March 31, 1905, p. 148.

25 Constant, op. cit., pp. 173-174.

26 City of Minneapolis, Proceedings of the City Council, XXXII, August 1, 1906, to August 10, 1906, pp. 444, 447-448.

27 Constant, op. cit., pp. 171-172.

28 Ibid., p. 173.

29 Ibid., pp. 172, 173, 175.

30 Ibid., pp. 172, 174.

31 Ibid., pp. 174-175.

32 Westbrook, op. cit., p. 18.

33 Constant, op. cit., p. 171.

34 Westbrook, op. cit., p. 10.

35 Minnesota Department of Transportation, Request for Determination of Eligibility, 1979.

36 City of St. Paul Department of Public Works, Bridge Departments, 1918.

37 Minnesota Department of Transportation (Howard, Needles, Tamman and Bergendoff), Preliminary Case Report, Lake Street/Marshall Avenue Bridge over the Mississippi River, 1981, p. 14.

38 Chisago County Bicentennial Committee, An Early Look at Chisago County, (1976), p. 14.

39 "Pioneer Engineer Dies at Age of 91," St. Paul Daily News, December 22, 1917.

40 R. M. Frame III, Historic Bridge Project, 1985, p. 10.

41 Josiah Blodget Chaney, "Early Bridges and Changes in the City of St. Paul,"
Minnesota Historical Society Collections, XII, 1908, pp. 132-134.

42 St. Paul Daily News, loc. cit.

43 Westbrook, op. cit., pp. 17-18.

44 City of Canton, Ohio (Richland Engineering Limited), Historic American Engineering Record, Third St. S.E. Bridge, 1982, p. 3.

45 E. T. Heald, The Stark County Story, I, 1949, pp. 629-630.

46 Westbrook, op. cit., p. 18.

47 Kane and Ominsky, op. cit., pp. 46, 47, 84.

48 Westbrook, op. cit., pp. 97-100.

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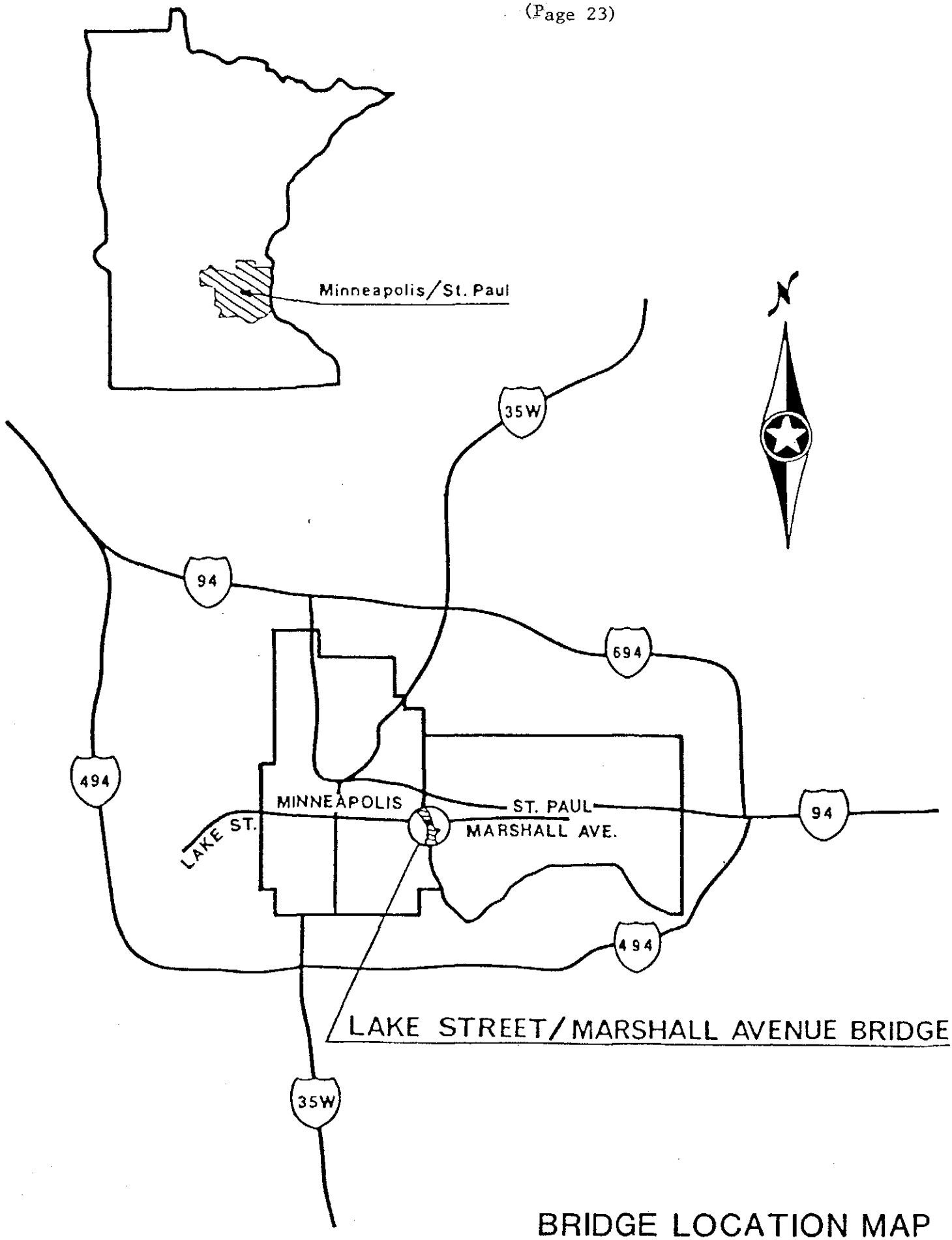
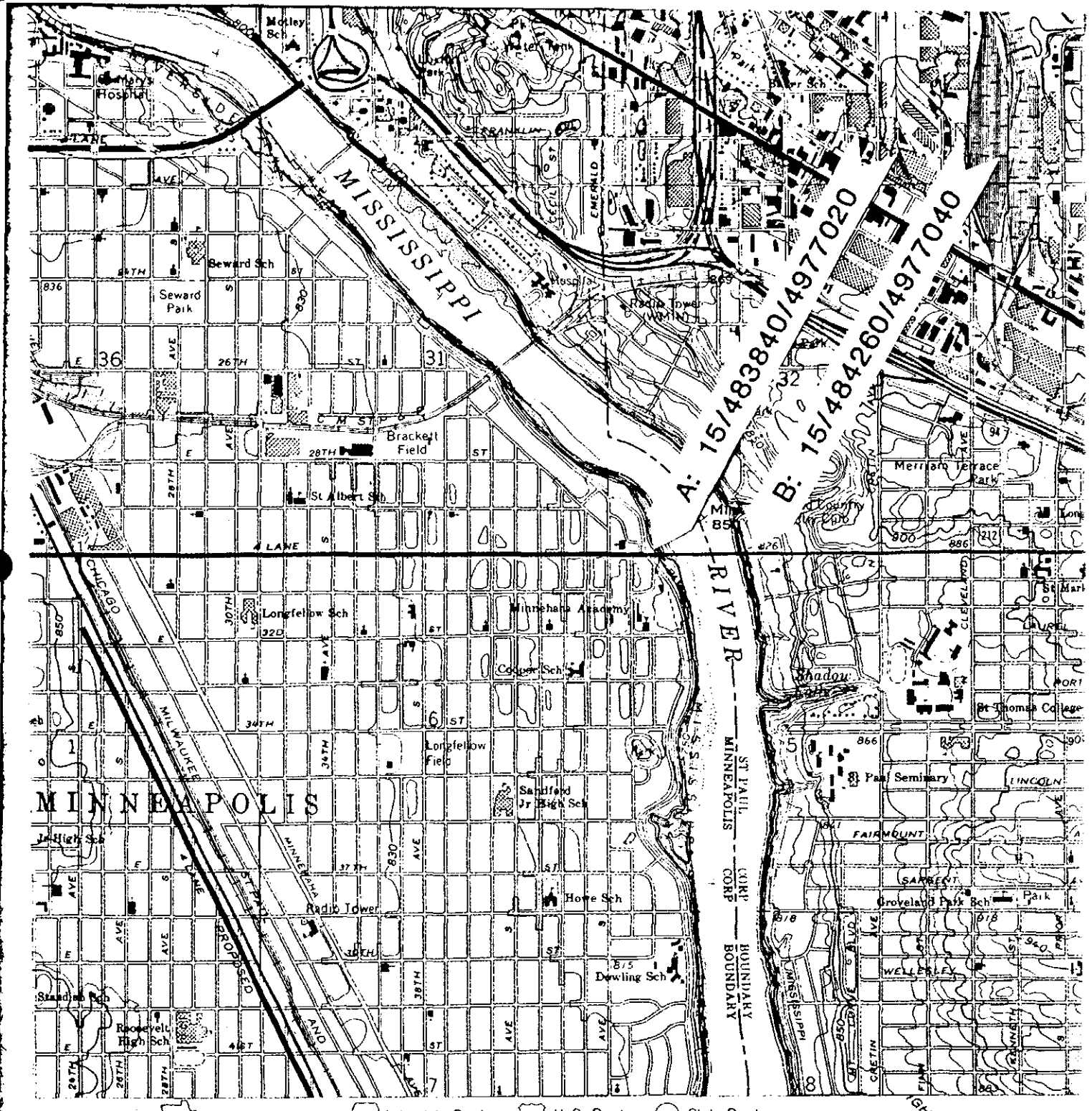


BRIDGE LOCATION MAP



ST. PAUL WEST, MINN.

NW/4 ST. PAUL 15' QUADRANGLE
N4452.5—W9307.5/7.5

1967
PHOTOREVISED 1972
AMS 7373 I NW—SERIES V872

242 Revisions shown in purple compiled from aerial photographs taken 1972. This information not field checked